ΣΥΓΧΡΟΝΕΣ ΑΠΟΨΕΙΣ
ΣΤΗ ΧΕΙΡΟΥΡΓΙΚΗ ΤΩΝ ΣΤΕΦΑΝΙΑΙΩΝ

Sotirios N. Prapas, MD FECTS
Director, A’ Cardiac Surgery Department
Henry Dunant Hospital Center
DISCLOSURE

• NO CONFLICT
Historical Milestones

1964

OPCAB (LIMA→LAD), Kolessov


Mammary artery-coronary artery anastomosis as method of treatment for angina pectoris

V. I. Kolessov, M.D., Ph. Leingrad, U.S.S.R.
Historical milestones

1967 FIRST CABG (SVG’s), Favaloro
Classic CABG, vein grafts
Historical milestones

1969

USE OF LIMA, Green

Left internal thoracic artery with pedicle
Historical milestones

Historical study

IMA on LAD better than SVG


CABG, LIMA + vein grafts
Historical milestones

1974

BILATERAL IMA’s,
Barner, Kay, Suzuki, Edwards
Coronary Artery Bypass Grafting by Utilizing In Situ Right Gastroepiploic Artery: Basic Study and Clinical Application

Hisayoshi Suma, MD, Hitoshi Fukumoto, MD, and Atsuro Takeuchi, MD

The Annals of Thoracic Surgery
1987;44:4:394-7

Historical milestones

1987

USE OF GEA, Suma, Pym, Carter

Hisayoshi Suma

1987: Coronary Artery Bypass Grafting by Utilizing In Situ Right Gastroepiploic Artery
Historical milestones

1971: First use of Radial

1991

RE-USE OF RADIAL, Acar

Alain Carpentier
1985

Institution of OPCAB (Buffolo-Benetti)


BENETTI, F. J.
Direct coronary artery surgery with saphenous vein bypass without either cardiopulmonary bypass or cardiac arrest.
Historical Milestones

1993

Commercial Stabilizers

Traditional stabilization of the heart. First years of OPCAB

Commercial stabilizer. The modern approach.
OVERCOME THE DIFFICULTY

We have overcome this difficulty since 1993 by placing several stitches in the posterior portion of the pericardial sac in such a way that there is exposure of the posterior arteries (OMB) with no hemodynamic stability.
Historical Milestones

1993

Intraluminal Shunt – Rivetti
Post training period, Brompton, London U.K.

My teacher in adult and pediatric surgery in London and the man who set up my thoughts

Darryl Shore

1991, Brompton Hospital.
N.Moat, D.Taggart, S.Prapas, V.Tsang
My inspiration

The efforts of innovators

BENETTI (Argentina)

CALAFIORE (Italy)

SUBRAMANIAN (USA)
Patients material

- **Age**: 1/3 of the patients >70 ετών with increased pressure [STS Data, 98].

- **Atherosclerosis of the aorta**: 13% of patients, percentage increases as age increases [Wareing TH, 92].

- **REDO**: Increase of percentage, STS mortality 6.25%.

- **Diabetics**: 30% of the patients planned for CABG.

- **High risk patients (˚EF, COPD, CRF, Previous stroke, PVD etc.):** increased acceptance with the beating heart technique.

---

**Increasing Number of Patients Aged over 65 Years in the Next Decade**

Konstantinides S et al.

Note dramatic increase in number and percentage of aged population
Can address the future operative volume in cardiothoracic surgery
Avoidance of all aortic manipulation reduces risk of CVA

- Muneretto et al JTCVS 2001
- Kim et al ATS 2002
- Taggart et al Postgrad Med J 2002

<table>
<thead>
<tr>
<th>Cannulate</th>
<th>X clamp</th>
<th>Side Bite</th>
<th>No Touch</th>
<th>Number</th>
<th>CVA %</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>567</td>
<td>2.3</td>
</tr>
<tr>
<td>ON</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>40</td>
<td>1.1</td>
</tr>
<tr>
<td>OFF</td>
<td>✓</td>
<td></td>
<td></td>
<td>2233</td>
<td>1.2</td>
</tr>
<tr>
<td>OFF</td>
<td></td>
<td></td>
<td>✓</td>
<td>1523</td>
<td>0.2</td>
</tr>
</tbody>
</table>

2 IMA’s are better than one

My attitude in OPCAB since my involvement

Partial x-clamping of the pulsative aorta

A procedure that I was worried about dissection or stroke
My attitude in OPCAB since my involvement
My attitude in OPCAB since my involvement
Τι γνωρίζουμε σήμερα?
FACTS

The knowledge of causes of death after surgery is essential to adopt preventive and therapeutic strategies to reduce the cardiovascular risk burden of patients where and when possible.

The importance of finding the murderer!

Michele Di Mauro, MD, PhD, Massimiliano Foschi, MD, Fabrizio Tancredi, MD, Garardo Liberti, MD, Antonio M. Calafiore, MD

July 2018
Volume 166, Issue 1, p1-166, e1-e40
Off pump vs. On pump

7083 OPCABG (48%) vs 7683 ONCABG (52%)

The survival benefit of OPCABG appears when predicted mortality risk >2.5%

The survival benefit of OPCABG increases as predicted mortality increases
Off pump vs. On pump

**STS Database**

* 42,471 patients in STS database analysed by 32 clinical risk factors
* OPCABG benefits both genders but females > males

<table>
<thead>
<tr>
<th>OUTCOME</th>
<th>Adjusted OR (95% CI) for OPCABG</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEATH</td>
<td>0.83 (0.69, 0.98)</td>
<td>0.03</td>
</tr>
<tr>
<td>Stroke</td>
<td>0.65 (0.52, 0.80)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>MI</td>
<td>0.67 (0.54, 0.84)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>MACE</td>
<td>0.71 (0.63, 0.81)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>LOS &gt; 14 days</td>
<td>0.70 (0.63, 0.78)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>
### Off pump vs. On pump

<table>
<thead>
<tr>
<th>RESPONSE</th>
<th>Studies</th>
<th>Patients</th>
<th>OR</th>
<th>p</th>
<th>NNT</th>
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<tbody>
<tr>
<td>Mortality</td>
<td>28</td>
<td>100,066</td>
<td>0.67</td>
<td>&lt;0.001</td>
<td>189</td>
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<tr>
<td>Stroke</td>
<td>22</td>
<td>55,290</td>
<td>0.42</td>
<td>&lt;0.001</td>
<td>104</td>
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<tr>
<td>Myocardial Infarct</td>
<td>14</td>
<td>35,951</td>
<td>0.97</td>
<td>.86</td>
<td>2685</td>
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<tr>
<td>AF</td>
<td>11</td>
<td>29,343</td>
<td>0.92</td>
<td>.20</td>
<td>79</td>
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<tr>
<td>Renal Failure</td>
<td>17</td>
<td>38,866</td>
<td>0.60</td>
<td>&lt;.0001</td>
<td>82</td>
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<tr>
<td>Prolonged ventilation</td>
<td>6</td>
<td>8,675</td>
<td>0.71</td>
<td>.01</td>
<td>116</td>
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<tr>
<td>IABP support</td>
<td>7</td>
<td>9,703</td>
<td>0.60</td>
<td>.01</td>
<td>245</td>
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<tr>
<td>Inotropic Support</td>
<td>7</td>
<td>6,153</td>
<td>0.59</td>
<td>.02</td>
<td>8</td>
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<tr>
<td>ReOP for bleeding</td>
<td>14</td>
<td>39,480</td>
<td>0.76</td>
<td>.06</td>
<td>195</td>
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<tr>
<td>RBC transfusion</td>
<td>8</td>
<td>16,685</td>
<td>0.36</td>
<td>&lt;.001</td>
<td>9</td>
</tr>
<tr>
<td>Wound Infection</td>
<td>13</td>
<td>33,030</td>
<td>0.59</td>
<td>&lt;.001</td>
<td>314</td>
</tr>
</tbody>
</table>

### Meta-analysis

Off-pump versus on-pump CABG: A systematic review and meta-analysis of propensity score analyses.
JKuss O, von Salviati B, Borgermann  *JTCVS 2010*

38 propensity matched studies of 123,137 patients

OPCABG Reduces All Mortality and Morbidity
OPCAB – Neurologic complications meta-analysis

Misfeld et al

Acquired Cardiovascular Disease

Neurologic complications after off-pump coronary artery bypass grafting with and without aortic manipulation: Meta-analysis of 11,398 cases from 8 studies

Martin Misfeld, MD, PhD, R. John L. Brereton, FRACS, Elizabeth A. Sweetman, MHM, and Gordon S. Doig, PhD

<table>
<thead>
<tr>
<th>Study of sub-category</th>
<th>no-op OPCAB</th>
<th>OPCAB</th>
<th>OR (fixed)</th>
<th>95% CI</th>
<th>Weight</th>
<th>OR (random)</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carof</td>
<td>9/15</td>
<td>5/20</td>
<td>1.50</td>
<td>0.99 – 2.30</td>
<td>15.00</td>
<td>0.10</td>
<td>(0.54 – 1.75)</td>
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<tr>
<td>Caye</td>
<td>6/22</td>
<td>1/23</td>
<td>2.20</td>
<td>0.10 – 4.54</td>
<td>1.20</td>
<td>0.10</td>
<td>(0.11 – 4.54)</td>
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<tr>
<td>Avest</td>
<td>2/9</td>
<td>3/29</td>
<td>3.20</td>
<td>1.31 – 6.18</td>
<td>3.20</td>
<td>0.10</td>
<td>(1.31 – 6.18)</td>
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<tr>
<td>Danese</td>
<td>17/10</td>
<td>7/67</td>
<td>2.00</td>
<td>0.69 – 5.21</td>
<td>2.00</td>
<td>0.10</td>
<td>(0.69 – 5.21)</td>
</tr>
<tr>
<td>Lefebvre</td>
<td>0/5</td>
<td>7/55</td>
<td>1.50</td>
<td>0.03 – 10.08</td>
<td>1.50</td>
<td>0.10</td>
<td>(0.03 – 10.08)</td>
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<tr>
<td>Kasprzak</td>
<td>4/47</td>
<td>6/25</td>
<td>2.87</td>
<td>0.78 – 10.09</td>
<td>2.87</td>
<td>0.10</td>
<td>(0.78 – 10.09)</td>
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<tr>
<td>Leu-Ran</td>
<td>1/12</td>
<td>2/7</td>
<td>2.30</td>
<td>0.10 – 5.28</td>
<td>2.30</td>
<td>0.10</td>
<td>(0.10 – 5.28)</td>
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<tr>
<td>Valdivia</td>
<td>3/20</td>
<td>3/6</td>
<td>2.83</td>
<td>0.46 – 0.29</td>
<td>2.83</td>
<td>0.10</td>
<td>(0.46 – 0.29)</td>
</tr>
</tbody>
</table>

Total 29 (no-op OPCAB), 81 (OPCAB)

Test for homogeneity: $\chi^2 = 7.56$, df = 7 ($P = 0.32$), $P = 0.44$

Test for overall effect: $\chi^2 = 3.35$, df = 8 ($P = 0.0888$)

RR:0.46: 95% CI 0.29-0.72; $p=0.0008$
On-Pump versus Off-Pump Coronary-Artery Bypass Surgery

A. Laurie Shroyer, Ph.D., Frederick L. Grover, M.D., Brack Hattler, M.D., Joseph F. Collins, Sc.D., Gerald O. McDonald, M.D., Elizabeth Kozora, Ph.D., John C. Lucke, M.D., Jane H. Baltz, R.N., and Dimitri Novitzky, M.D., Ph.D. for the Veterans Affairs Randomized On/Off Bypass (ROOBY) Study Group

![Graph showing survival probability over days after surgery with On-Pump vs Off-Pump treatment]

- 966 Patients were assessed for eligibility
  - 7460 Were excluded
    - 2716 Had diffusely diseased or small target vessels
    - 2461 Had a surgeon who was not a participant or coordinator who was not available
    - 1467 Did not give consent
    - 1282 Had other reason

- 1104 Were assigned to off-pump group
  - 966 Received intervention
  - 137 Were converted to on-pump group
  - 1 Did not undergo CABG

- 1099 Were assigned to on-pump group
  - 1054 Received intervention
  - 43 Were converted to off-pump group
  - 2 Did not undergo CABG

- 1104 Were included in 30-day follow-up
- 1099 Were included in 30-day follow-up

70 ΧΡΟΝΙΑ ΚΑΡΔΙΟΛΟΓΙΑΣ (ΕΚΕ)
70 YEARS OF CARDIOLOGY (HSC)
ΠΑΝΕΛΛΗΝΙΟ ΚΑΡΔΙΟΛΟΓΙΚΟ ΣΥΝΕΔΡΙΟ
PANHellenic Congress of Cardiology

www.HCS.GR
My attitude in OPCAB since my involvement

OPCAB: Personal opinion

- Demands special training and loyalty in the method.
- It can not be part of a surgery practice.
- May estimate the natural flow of diseased vessels avoiding competition.
- Great choice of suitable point for anastomoses.

Frequency of stroke according to aortic manipulation

ANAORTIC CORONARY SURGERY
SUPERIORITY OF BIMA GRAFTS

The most effective therapy still underutilized for Multivessel CAD patients globally

- U.S.A: 3,5-4,5 %
- AUSTRALIA: 3,6-6,3 %
- EUROPE: 12-30,6 %
- JAPAN: 23-61 %
- Syntax study: 27,6 %
Arterial grafts: Functional properties of the mammary
Functional properties of the mammary

Internal laminae

• Continuous on IMAs

• Non-continuous on the rest arteries

Compared with all other arterial and venous conduits, it shows increased production of anti-inflammatory and vasoactive molecules, particularly nitric oxide.
Retrospective comparison BIMA-LIMA

Improved Survival with 2 IMA Conduits


A meta-analysis of adjusted hazard ratios from 20 observational studies of bilateral versus single internal thoracic artery coronary artery bypass grafting

- 20 observational studies
- 70.897 pts pooled analysis
- **BIMA associated with significant reduction in long-term mortality relative to SIMA**
- Benefit of BIMA increased in studies with higher proportions of males
A meta-analysis comparing bilateral internal mammary artery with left internal mammary artery for coronary artery bypass grafting

Aaron J. Weiss, Shan Zhao, David H. Tian, David P. Taggart, Tristan D. Yau

ART STUDY

Prospective comparison BIMA-LIMA

DEATH/MI/STROKE AT 10 YEARS (Intention To Treat)

HR (95% CI) = 0.90 (0.78, 1.03)

p = 0.12

AT analysis (LITA+RA/BITA vs LITA): HR 0.80 (0.69, 0.93)
Prospective comparison BIMA-LIMA

Explanations for Negative ART Findings?

- Sample size calculation based on earlier studies. Mortality less than predicted
- > 15% crossover in the BITA group
- > 20% of SITA patients had a Radial Artery graft*

Radial Artery Beneficial in ART

Figure 2. Cumulative incidence of myocardial infarction (MI), revascularization, cardiovascular (CV) death, and the composites of major adverse cardiac events (MACE) in the radial artery (RA) and saphenous vein graft (SVG) group after matching.
RIMA compared with RA

• similar operative mortality

• superior long-term survival favors RIMA

• freedom from repeat revascularization, favors RIMA

• Similar incidence of sternal wound complication when the skeletonized harvesting technique was used.
Radial Artery-Conclusions

- RA is viable 2\textsuperscript{nd} (or 3\textsuperscript{rd}) arterial conduit in terms of Patency and Clinical outcomes vs. SVGs, at least in longer term studies

- Clinical superiority of the RA vs RIMA is uncertain even though the RIMA is biologically identical to the LIMA

- RA should be grafted to target vessels with high grade lesions

- RA is advantageous in DM patients
Grafts in use

The most common grafting patterns in our practice are:

Left internal thoracic artery (ITA) to the left anterior descending artery

Right ITA in situ or RADIAL to the first marginal

SVG to the posterior descending artery with or without.
Total arterial revascularization

Multiple arterial bypass grafting should be routine

Robert F. Tranbaugh, MD, David J. Lucido, PhD, Kamellia R. Dimitrova, MD, Darryl M. Hoffman, MD, Charles M. Geller, MD, Gabriela R. Dincheva, BS, John D. Puskas, MD

- An 80% rate of MABG has the potential to prevent more than 10,000 deaths annually and add >64,000 person-years of life over the course of 10 years.

- The use of a second arterial graft during CABG should be routine in the majority of patients undergoing CABG.

December 2015 Volume 150, Issue 6, Pages 1537–1545
Total Arterial Revascularization

Is the Holy Grail for CABG but…
Wisdom in the use of arterial conduits.

Where do they stand between IMA and SVG?
The Right Internal Thoracic Artery: The Forgotten Conduit—5,766 Patients and 991 Angiograms

James Tatoulis, MD, FRACS, Brian F. Buxton, MS, FRACS, and John A. Fuller, FRACP

Departments of Cardiothoracic Surgery, Royal Melbourne Hospital, Epworth Hospital, and University of Melbourne, Melbourne, Australia

The Right Internal Thoracic Artery: The Forgotten Conduit—5,766 Patients and 991 Angiograms

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Departments of Cardiothoracic Surgery, Royal Melbourne Hospital, Epworth Hospital, and University of Melbourne, Melbourne, Australia

Patency according to target
Free compared with pedicled RIMA

Free Compared with Pedicled Right Internal Thoracic Arteries for Coronary Artery Bypass Grafting

J. Tatoulis, B. F. Buxton, J. A. Fuller

<table>
<thead>
<tr>
<th>Grafts</th>
<th>2years</th>
<th>4years</th>
<th>6years</th>
<th>8years</th>
<th>10years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedicled RIMA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>n=323</td>
<td>98</td>
<td>94</td>
<td>94</td>
<td>94</td>
<td>94</td>
</tr>
<tr>
<td>Free RIMA</td>
<td>96</td>
<td>93</td>
<td>89</td>
<td>82</td>
<td>79</td>
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<tr>
<td>n=313</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
Tatoulis’ experience

target

stenosis
BIMA Composite Y-grafts

Bilateral Internal Thoracic Artery Configuration for Coronary Artery Bypass Surgery  
David Glineur, Munir Boodhwani, Claude Hanet, Laurent de Kerchove, Emiliano Navarra, Parla Astarchi, Philippe Noirhomme, and Gebrine El Khoury

Advantages

❖ Each IMA is used in situ
❖ The RIMA does not cross the midline of the chest
❖ LIMA to LAD

Disadvantages

❖ Grafting of medial or distal marginal branches
❖ The anastomotic site is often small and very muscular
❖ The possibilities of making sequential anastomosis is poor
❖ If multiple marginal branches have to be grafted, an accessory graft is necessary

❖ Complete myocardial revascularization with 2 IMAs
❖ RIMA does not cross the midline
❖ No need to completely harvest the RIMA

❖ The flow capacity has been debated
❖ Possibility of a “steal phenomenon”
❖ Risk of competitive flow
❖ Can induce kinking

BIMA Composite Y-grafts

Kaplan–Meier major adverse cardiac cerebrovascular event long-term comparison.

Mortality

MI

Stroke

Revascularization

Total MACE

Historical milestones

1981

SEQUENTIAL USE OF IMA
Barner, Kabbani, Mc Bride

The Achille’s heel of Arterial Sequential Grafting is
The flow competition

Native coronary artery stenosis should be
>90%
Frequent Situations of Flow Competition

Sequentials

SUGGESTIONS

1. Small arteriotomies.
2. Avoidance of “Seagull Phenomenon” (e.g. in intramuscular coronaries).
3. Avoidance of wide angles.
4. Sequence: Final anastomosis on the vessel with the greatest stenosis.


(1) sequential to two branches each with 75% stenosis

(2) end to 75% branch / proximal to 99-100% branch
Sequential Anastomoses

In 1361 patients (41%) there were sequential anastomoses performed

Mean 0.65 per patient

LIMA sequ D + LAD
Any place for Vein Graft “Y- SVG” Grafts

Saphenous Vein Graft
When is it the preferred conduit?

Impact of Patient and Target-Vessel Characteristics on Arterial and Venous Bypass Graft Patency. Insight From a Randomized Trial

Desai et al  February 13, 2007

Impact of severity of proximal target-vessel stenosis on RA and SVG patency.

Impact of size of distal target vessel on RA and SVG patency.
Any place for Vein Graft
“Y- SVG” Grafts

Equivalency of Saphenous Vein and Arterial Composite
Grafts: 5-Year Angiography and Midterm Clinical Follow-Up

Ho Young Hwang, MD, PhD, Kyung-Hak Lee, MD, Jung Wook Han, MD, Ki-Bong Kim, MD, PhD

The SV composite grafts were equivalent to arterial composite grafts in terms of 5-year graft patency rates and midterm clinical outcomes.

Only End-to-Side Anastomosis to avoid kinking
Any place for Vein Graft
“Y- SVG” Grafts

12 years

From our data

The “no-touch” technique, (SVG is harvested with perivascular fat tissue), has recently been shown to improve long-term (16 years) patency of SVG (83%) compared with a conventional method (64%) and was shown to be related to decreased early vascular smooth muscle cell activation, the basic mechanism of neointimal hyperplasia.
Any place for Vein Graft- “no-touch” SV

The “no-touch” harvesting technique for vein grafts in CABG surgery preserves an intact vasa vasorum. Dreifaldt et al.

Transmission electron microscopic features of vasa vasorum in NT (A–C) and CT (D–E) saphenous vein graft preparations. Note the open lumen in all vasa vessels in NT preparations (A–C); also note the presence of red blood cells within the luminal space (lu). In CT preparations vasa are frequently collapsed or constricted so that the luminal space is closed and not readily visible (D). In (E) note the damage to a vasa vessel by CT harvesting; also note red blood cells outside the vascular pool. In contrast, image (F) shows a rather well-preserved vessel. Original magnifications: A, D, 35600; B, E, F, 32650; C,34400

Bleeding from an incised vasa vasorum of SV graft harvested with the NT technique (screen shot from the video).
Any place for Vein Graft
“Y- SVG” Grafts
The better the initial SVG condition and surgical technique, the fewer the resources needed to maintain its patency.

In vitro and animal model data have shown that preservation solutions may influence endothelial function and SVG failure.

A recent clinical study showed that buffered saline solution was superior to saline and even heparinized blood.

Any place for Vein Graft

• Suggestions:

  • SV graft is recommended to bypass the RCA with less than a critical stenosis
  
  • SV graft may still perform well in the right environment
  
  • SV graft is a preferred conduit for CABG along with left IMA

2015 STS GUIDELINES ON ARTERIAL CONDUITS FOR CORONARY ARTERY BYPASS GRAFTING
An arterial graft should not be used to bypass the right coronary artery with less than a critical stenosis (<90%) (COR III, LOE C)
DIABETICS
Whether coronary artery bypass grafting (CABG) or percutaneous coronary intervention (PCI) is the preferred revascularisation method in patients with multivessel coronary artery disease, particularly in those with diabetes, has been highly debated in the cardiovascular community for more than 20 years.

CABG has been consistently superior to PCI for the endpoint of repeat revascularisation.

<table>
<thead>
<tr>
<th>Diagnoses</th>
<th>Three-vessel CAD without diabetes mellitus</th>
<th>Three-vessel CAD with diabetes mellitus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Three-vessel disease with low SYNTAX score (0–22).</td>
<td>I</td>
<td>I</td>
</tr>
<tr>
<td>Three-vessel disease with intermediate or high SYNTAX score (&gt;22).</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Three-vessel disease with low SYNTAX score (0–22).</td>
<td>I</td>
<td>I</td>
</tr>
<tr>
<td>Three-vessel disease with intermediate or high SYNTAX score (&gt;22).</td>
<td>I</td>
<td>I</td>
</tr>
</tbody>
</table>

**Diabetes**
π-graft: Greek psi (ψ) - graft arrangement

In diabetic cases with very small targets (vessels), in order to increase the total runoff.
The long-term impact of diabetes on graft patency after coronary artery bypass grafting surgery: A substudy of the multicenter Radial Artery Patency Study


- 148 of 529 patients (27.8%) with diabetes
- 269 patients (83/269 [30.9%] diabetic) underwent angiography at mean of 7.7 ± 1.5 years after surgery.
- The proportion of complete graft occlusion was significantly lower in the RA grafts (4/83 [4.8%]) than in the SVG grafts (21/83 [25.3%]) (P = .0004)

The use of RA should be strongly considered in diabetics undergoing coronary bypass surgery, especially with high-grade target vessel stenosis.
Off-pump or on-pump coronary artery bypass grafting in diabetes: Is this the important question?

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From the Department of Cardiovascular Surgery, Mayo Clinic, Rochester, Minn.

Disclosure: Author has nothing to disclose with regard to commercial support.

Received for publication Aug 28, 2018; accepted for publication Aug 28, 2018.

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J Thorac Cardiovasc Surg 2018; 156: e1–e2

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https://doi.org/10.1016/j.jtcvs.2018.08.009

Central Message

In patients with diabetes, off-pump and on-pump CABG result in similar long-term survivals. The use of skeletonized BITA may be more important to increasing longevity in patients with diabetes.

Risk factors for SWC

Skeletonized BIMA is Associated with Lower SWI

Skeletonized Internal Thoracic Artery Harvest Improves Prognosis in High-Risk Population After Coronary Artery Bypass Surgery for Good Quality Grafts

Xiang Hu and Qiang Zhao

Ann Thorac Surg 2011;92:48-58
Should the ITA be skeletonized?

Clip – clip – cut (plus Bovie diathermy)

Harmonic scalpel

Skeletonized Internal Thoracic Artery Harvest Reduces Pain and Dysesthesia and Improves Sternal Perfusion After Coronary Artery Bypass Surgery: A Randomized, Double-Blind, Within-Patient Comparison

- Does Skeletonization cause arterial injury? **NO**
- Does Skeletonization Affect graft patency? **NO**
- Does Skeletonization Affect flow? **YES**
  - Better intraoperative free flow from skeletonized mammary
Publications

Female risk using OPCAB, pl-circuit, and aorta no-touch coronary revascularization.
Prapas SN, Panagiotopoulos IA, Ayvaz MA, Kotasis VN, Protopapas DA, Linardakis IN, Trantas T, Papanikolaou EF, 
Department of Cardiac Surgery, Henry Dunant Hospital, Meisionion 107, Athens GR 11521, Greece. 
sprapas@hdonanthospi.gr

Microbiologically documented nosocomial infections after coronary artery bypass surgery without cardiopulmonary bypass.
Falagas ME, Rosmarakis ES, Rellos K, Michalopoulos A, Samonis G, Prapas SN.
Alfa Institute of Biomedical Sciences, Athens, Greece. m.falagas@alibs.gr

Aorta no-touch off-pump coronary artery revascularization in octogenarians: 5 years' experience.
Prapas SN, Panagiotopoulos IA, Pentaev DH, Ayvaz MA, Protopapas DA, Kotasis VN, Linardakis IN, Trantas T, Papanikolaou EF, 
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Microbiologically documented nosocomial infections after coronary artery bypass surgery without cardiopulmonary bypass
Matthew E. Falagas, MD, MSc Evangelos S. Rosmarakis, MD Konstantinos Rellos, MD Argyris Michalopoulos, MD, FCCP George Samonis, MD, PhD Sotirios N. Prapas, MD

A prospective cohort study was performed at Henry Dunant Hospital, Athens, Greece. It included all adult patients who underwent coronary artery bypass grafting with no valve surgery and without the use of cardiopulmonary bypass during a period of 3 years. Case patients were those with development of microbiologically documented nosocomial infections. Various variables were examined as possible risk factors for nosocomial infections.

Results
Twenty-one of 782 studied patients (2.7%) acquired 26 microbiologically documented nosocomial infections after off-pump coronary artery bypass grafting. Eight of 782 studied patients had pneumonia (1.02%), 7 of 782 (0.90%) had bacteremia, 4 of 782 (0.51%) had superficial wound infection at the sternotomy site, 4 of 782 (0.51%) had urinary tract infection, 2 of 782 (0.26%) had mediastinitis, and 1 of 782 (0.13%) had pressure sore infection. There was a statistically significant difference in mortality between patients with and without nosocomial infection (23.8% vs 1.2%, \( P < .001 \))
Octogenarians

<table>
<thead>
<tr>
<th>FAVOURS PCI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Clinical characteristics</strong></td>
</tr>
<tr>
<td>Presence of severe co-morbidity (not adequately reflected by scores)</td>
</tr>
<tr>
<td>Advanced age/frailty/reduced life expectancy</td>
</tr>
<tr>
<td>Restricted mobility and conditions that affect the rehabilitation process</td>
</tr>
<tr>
<td><strong>Anatomical and technical aspects</strong></td>
</tr>
<tr>
<td>MVD with SYNTAX score 0-22</td>
</tr>
<tr>
<td>Anatomy likely resulting in incomplete revascularization with CABG due to poor quality or missing conduits</td>
</tr>
<tr>
<td>Severe chest deformation or scoliosis</td>
</tr>
<tr>
<td>Sequelae of chest radiation</td>
</tr>
<tr>
<td>Porcelain aorta*</td>
</tr>
</tbody>
</table>
Stroke

Perioperative stroke occurred in 6% of patients undergoing CABG and resulted in a six-fold higher mortality. Two common causes are embolization (atheroma, air, calcified debris) and hypotension resulting in inadequate perfusion of the central nervous system.

Current status of CABG in octogenarians

The pooled estimate of 30-day mortality of CABG in octogenarians was 7.3% (6.3e8.2%) and 1-year survival rate was 86% (83e88%), similar to PCI [5.4% (4.4e6.4%) and 87% (84e91%)]
Off pump vs. On pump

<table>
<thead>
<tr>
<th>Event</th>
<th>N=2539: 1 yr</th>
<th>OFF %</th>
<th>ON %</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>13.1</td>
<td>14.0</td>
<td>.48</td>
<td></td>
</tr>
<tr>
<td>Death</td>
<td>7.0</td>
<td>8.0</td>
<td>.38</td>
<td></td>
</tr>
<tr>
<td>MI</td>
<td>2.1</td>
<td>2.4</td>
<td>.7</td>
<td></td>
</tr>
<tr>
<td>Stroke</td>
<td>3.5</td>
<td>4.4</td>
<td>.26</td>
<td></td>
</tr>
<tr>
<td>New dialysis</td>
<td>2.9</td>
<td>3.5</td>
<td>.37</td>
<td></td>
</tr>
<tr>
<td>REVASC</td>
<td>3.1</td>
<td>2.0</td>
<td>.11</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Event</th>
<th>N=2539: 30 d</th>
<th>OFF %</th>
<th>ON %</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>7.8</td>
<td>8.2</td>
<td>.74</td>
<td></td>
</tr>
<tr>
<td>Death</td>
<td>2.6</td>
<td>2.8</td>
<td>.55</td>
<td></td>
</tr>
<tr>
<td>MI</td>
<td>1.5</td>
<td>1.7</td>
<td>.79</td>
<td></td>
</tr>
<tr>
<td>Stroke</td>
<td>2.2</td>
<td>2.7</td>
<td>.47</td>
<td></td>
</tr>
<tr>
<td>New dialysis</td>
<td>2.4</td>
<td>3.1</td>
<td>.80</td>
<td></td>
</tr>
<tr>
<td>REVASC</td>
<td>1.3</td>
<td>0.4</td>
<td>.04</td>
<td></td>
</tr>
</tbody>
</table>

2539 patients > 75 years
Experience: 322 OPCAB vs 578 ON
Predicted mortality 3.8%
Mean number of grafts 2.7 vs 2.8

1-Year Event Free Survival
HR=0.93 (0.76-1.16;p=0.48)

Elderly patients
Retrospective comparison BIMA-LIMA

Superiority of BIMA on Survival even in older patients in OPCAB surgery

Off-pump Bilateral Skeletonized Internal Thoracic Artery Grafting in Elderly Patients
Takeshi Kinoshita, Tohru Asai, Tomoaki Suzuki, Satoshi Kuroyanagi, Soh Hosoba and Noriyuki Takashima
Ann Thorac Surg 2012;93:531-536

Fig 1. Survival free from overall death. (ITA = internal thoracic artery)

Fig 2. Survival free from cardiac event. (ITA = internal thoracic artery)
Publications

**Female risk using OPCAB, pi-circuit, and aorta no-touch coronary revascularization.**
Prapas SN, Panagiotopoulos IA, Ayad MA, Kotsis VN, Protegeras DA, Linardakis IN, Tzanavaras TP, Danou PN.
Department of Cardiac Surgery, Henry Dunant Hospital, Mesogion 107, Athens GR 11521, Greece. sprapas@hdunanthospi.gr

**Nosocomial infections after off-pump coronary artery bypass surgery: frequency, characteristics, and risk factors.**
Evangelos S., Panagiotopoulou IA., Protogerou DA., Kotsis VN., Linardakis IN., Tzanavaras TP., Stratigi PT.
Department of Cardiac Surgery, Henry Dunant Hospital, Mesogion 107, Athens GR 11521, Greece. sprapas@hdunanthospi.gr

**Aorta no-touch off-pump coronary artery revascularization in octogenarians: 5 years' experience.**
Prapas SN, Panagiotopoulos IA, Pentchev DN, Ayad MA, Protogeros DA, Kotsis VN, Linardakis IN, Tzanavaras TP, Stratigi PT.
Department of Cardiac Surgery, Henry Dunant Hospital, Mesogion 107, Athens GR 11521, Greece. sprapas@hdunanthospi.gr

**Impact of obesity on outcome of patients undergoing off-pump coronary artery bypass grafting using aorta no-touch technique.**
Department of Cardiac Surgery, Henry Dunant Hospital, Athens, Greece.

**Predictors of prolonged mechanical ventilation following aorta no-touch off-pump coronary artery bypass surgery.**
Prapas SN, Panagiotopoulou IA, Hamed Abdel-Hamid A, Kotsis VN, Protogerou DA, Linardakis IN, Danou PN.
Department of Cardiac Surgery, Henry Dunant Hospital, Athens, Greece.
Aorta no-touch off-pump coronary artery revascularization in octogenarians: 5 years' experience.
Prapas SN, Panagiotopoulos IA, Pentchev DN, Ayyad MA, Protogeros DA, Kotsis VN, Linardakis IN, Tzanavaras TP, Stratigi PT.

BACKGROUND:
Approximately 18% of octogenarians have ischemic heart disease. Increasingly, they are being referred for coronary artery revascularization by surgical and/or percutaneous procedures. These strategies have been questioned, however, because of reports of poor outcomes in the elderly. In this study, we aimed to determine the impact of age on morbidity and mortality in patients undergoing off-pump coronary artery bypass (OPCAB) with the π-circuit procedure during 5 years of follow-up.

MATERIALS AND METHODS:
From February 2001 to November 2005, 1359 patients underwent isolated coronary revascularization with the π-circuit technique, which consists of (1) beating heart surgery, (2) OPCAB, (3) no touching of the aorta, (4) use of composite grafts, and (5) arterial revascularization. Sixty-two patients were > or = 80 years of age (group A), and 1297 were <80 years old (group B). Both groups were compared with respect to preoperative risk factors, intraoperative parameters, and postoperative morbidity and mortality. Follow-up lasted from 4 to 60 months. Data were analyzed with the chi(2) test, the Fisher exact test, the Kaplan-Meier method, and the Cox model of regression analysis.

RESULTS:
Female predominated among the octogenarians (P < .0005). Octogenarians more frequently underwent emergent operations (P < .031) and had worse ejection fractions (P < .026). Obesity was also less prevalent among these patients (P < .007). There were no differences between the groups in the preoperative and postoperative use of an intraaortic balloon pump. Octogenarians had lower cholesterol levels (P < .0005) and had fewer distal anastomoses (2.24 + or - 0.76 versus 2.77 + or - 0.92, P < .0005). The 2 groups were not significantly different with respect to 30-day mortality (3.2% versus 1.5%) and 7-day mortality (1.6% versus 0.2%). Differences were noted in the incidences of pulmonary complications (12.9% versus 5.6%, P < .027), atrial fibrillation (41.9% versus 19%, P < .0005), and cognitive disturbances (6.5% versus 0.3%, P < .0005). During follow-up, survival seemed to favor the younger group (P < .001). Nevertheless, further analysis of the data with the Cox regression model to exclude confounding risk factors, revealed the survival rates of the 2 groups to be similar.

CONCLUSIONS:
Use of the π-circuit technique is very effective for octogenarians. Although these older patients have a higher incidence of early postoperative morbidity, overall survival is not affected.
The π-graft method Mid-term results (5 years)

Octagenarians
P=NS

Diabetes
P=NS

Renal Failure
P=NS

Gender
P=NS
The π-graft method Mid-term results (5 years)

**PREDICTORS OF MORTALITY**

- **FEMALE GENDER**: 2.5 times more likely
- **EMERGENCY**: 5.1 times more likely
- **POOR EF**: 61% more likely
- **PREOP. IABP**: 5.5 times more likely
Advancing the State of the Art in Surgical Coronary Revascularization

John D. Puskas, MD, MS, Bobby Yanagawa, MD, PhD, and David P. Taggart, MD, PhD

Department of Cardiothoracic Surgery, Mount Sinai Beth Israel, New York, New York; Division of Cardiovascular Surgery, St. Michael’s Hospital, University of Toronto, Toronto, Ontario, Canada; and Nuffield Department of Surgery, University of Oxford, John Radcliffe Hospital, Oxford, United Kingdom

• Recommended **bypassing LAD with IMA, not just LIMA**

• Recommended **use of “a second arterial conduit”**

• Recommend **BITA grafting** when risk of DSWI acceptable

• Recommend **skeletonized BITA smoking cessation, glycemic control, rigorously stable sternal closure to minimize risk of DSWI**

• **RA graft, for “severe stenosis”**

• **Does for arterial not include an age threshold revascularization**

• Beware native **competitive flow** patterns during complex multiarterial grafting. Composite arterial conduits should be designed to avoid unbalanced competitive flow.

• **Precise anastomotic technique** is essential

Ann Thorac Surg 2016;101:419-21
Isolated CABG n=3517: February 2001 – May 2016

- Distal anastomoses: 2.8
- Arterial anastomoses: 2.5
Arterial conduits, n=6813 (1.94/pt)

- LITA, n=3466 (0.98/pt)
- RA, n=868 (0.25/pt)
- RITA, n=2479 (0.71/pt)

Isolated CABG n=3517: February 2001 – May 2016
The technique: Pre-constructions

Left sided

SEQUENCIAL USE

T-GRAFT (Tector)

Π-GRAFT (Prapas)

Y-GRAFT (Calafiore)

EXTENSIONS (I-graft)
With radial, SVG or d. LIMA

radial

proxRIMA

d. LIMA

RIMA
π-graft. In-situ arrangement
π-graft. Long Y- graft arrangement

Curved course of LIMA towards to the lateral wall to save length for FRIMA.

Left Pleura Closed – Creation of a tunnel between pleura and mediastinal adipose
Anaortic coronary surgery using the P-circuit is associated with a low incidence of perioperative neurological complications

Anaortic coronary surgery using the Π-circuit is associated with a low incidence of perioperative neurological complications

Sotirios Prapas, Antonio Maria Calafiore, Konstantinos P Katsavrias, Ioannis A Panagiotopoulos, Ioannis N Linardakis, Fabrizio Tancredi, Massimiliano Foschi, Michele Di Mauro


Published: 11 June 2018 Article history ▼


Published: 11 June 2018 Article history ▼

Table 1: Preoperative and operative data

<table>
<thead>
<tr>
<th>Variables</th>
<th>n = 3081</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years, continuous), mean ± SD</td>
<td>66 ± 10</td>
</tr>
<tr>
<td>Age class (years), n (%)</td>
<td>942 (31)</td>
</tr>
<tr>
<td>&lt;50</td>
<td>1049 (34)</td>
</tr>
<tr>
<td>&gt;50</td>
<td>1090 (35)</td>
</tr>
<tr>
<td>Gender, n (%)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>412 (13)</td>
</tr>
<tr>
<td>Male</td>
<td>2669 (87)</td>
</tr>
<tr>
<td>Emergency, n (%)</td>
<td>255 (8)</td>
</tr>
<tr>
<td>Ejection fraction (%), n (%)</td>
<td></td>
</tr>
<tr>
<td>&lt;50</td>
<td>2068 (67)</td>
</tr>
<tr>
<td>&gt;50</td>
<td>812 (26)</td>
</tr>
<tr>
<td>CRF</td>
<td>201 (7)</td>
</tr>
<tr>
<td>BMI (kg/m²), mean ± SD</td>
<td>28 ± 5</td>
</tr>
<tr>
<td>Obese, n (%)</td>
<td>19 (0.6)</td>
</tr>
<tr>
<td>Diabetic, n (%)</td>
<td>1034 (34)</td>
</tr>
<tr>
<td>Hypercholesterolemia, n (%)</td>
<td>1654 (54)</td>
</tr>
<tr>
<td>Hypertension, n (%)</td>
<td>1655 (55)</td>
</tr>
<tr>
<td>Chronic pulmonary disease, n (%)</td>
<td>241 (7)</td>
</tr>
<tr>
<td>Preoperative AF, n (%)</td>
<td>185 (4)</td>
</tr>
<tr>
<td>ECV, n (%)</td>
<td>281 (9)</td>
</tr>
<tr>
<td>Previous CVA, n (%)</td>
<td>124 (4)</td>
</tr>
<tr>
<td>Stroke</td>
<td>75 (2)</td>
</tr>
<tr>
<td>TIA</td>
<td>49 (1)</td>
</tr>
<tr>
<td>Preoperative IABP, n (%)</td>
<td>64 (2)</td>
</tr>
<tr>
<td>Previous cardiac operation, n (%)</td>
<td>149 (5)</td>
</tr>
<tr>
<td>Off-pump conversion to on-pump, n (%)</td>
<td>4 (0.1)</td>
</tr>
<tr>
<td>Mean number of anastomoses, mean ± SD</td>
<td>2.8 ± 0.9</td>
</tr>
<tr>
<td>Mean number of arterial anastomoses, mean ± SD</td>
<td>2.6 ± 1.0</td>
</tr>
<tr>
<td>Conduit grafted to coronary bed, n (%)</td>
<td></td>
</tr>
<tr>
<td>LIMA</td>
<td>3027 (98)</td>
</tr>
<tr>
<td>RIMA</td>
<td>2178 (71)</td>
</tr>
<tr>
<td>RA</td>
<td>867 (26)</td>
</tr>
<tr>
<td>SVG</td>
<td>536 (17)</td>
</tr>
</tbody>
</table>

AF: atrial fibrillation; BMI: body mass index; CRF: chronic renal failure; CVA: cerebrovascular accident; ECV: extracardiac vasculopathy; IABP: intra-aortic balloon pump; LIMA: left internal mammary artery; RA: radial artery; RIMA: right internal mammary artery; SD: standard deviation; SVG: saphenous vein graft; TIA: transient ischaemic attack.
Isolated CABG n=3517: February 2001 – May 2016

- <70 y: 61.1%
- 70-79 y: 32.2%
- ≥80 y: 6.7%
Ejection fraction

>50%: 65.0%

36-50%: 27.6%

≤35%: 7.3%

Isolated CABG n=3517: February 2001 – May 2016
Anaortic coronary surgery using the P-circuit is associated with a low incidence of perioperative neurological complications

Table 2: Risk factors for a postoperative cerebrovascular accident

<table>
<thead>
<tr>
<th>Variables</th>
<th>Univariable analysis OR (95% CI)</th>
<th>Multivariable analysis OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age class</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;60 (942 patients)</td>
<td>Reference</td>
<td>Reference</td>
</tr>
<tr>
<td>61-70 (1049 patients)</td>
<td>3.6 (1.4-12.1)</td>
<td>3.8 (0.8-9.6)</td>
</tr>
<tr>
<td>&gt;70 (1090 patients)</td>
<td>7.8 (1.9-17.4)</td>
<td>5.8 (1.7-13.2)</td>
</tr>
<tr>
<td>Diabetes (1034 patients)</td>
<td>4.9 (1.6-14.9)</td>
<td>4.0 (1.3-13.1)</td>
</tr>
<tr>
<td>ECV (281 patients)</td>
<td>4.0 (1.3-10.1)</td>
<td>2.7 (1.1-7.8)</td>
</tr>
<tr>
<td>Previous CVA (124 patients)</td>
<td>4.1 (1.1-9.3)</td>
<td></td>
</tr>
<tr>
<td>Previous CRF (61 patients)</td>
<td>8.4 (1.9-18.3)</td>
<td>5.3 (1.1-15.3)</td>
</tr>
</tbody>
</table>

Hosmer–Lemeshow test P-value 0.83, C-statistic 0.82.
CI: confidence interval; CRF: chronic renal failure; CVA: cerebrovascular accident; ECV: extracardiac vasculopathy; OR: odds ratio.
Isolated CABG n=3517: February 2001 – May 2016
Isolated CABG n=3517: February 2001 – May 2016

- pre CRF: 6.3%
- dialysis: 1.6%
- pre CVA: 4.0%
- redo: 5.1%
- COPD: 7.1%
Isolated CABG n=3517: February 2001 – May 2016

- Emergency: 8.0%
- Pre IABP: 2.3%
Anaortic coronary surgery using the P-circuit is associated with a low incidence of perioperative neurological complications.

Table 3: Postoperative complications

<table>
<thead>
<tr>
<th>Complication</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute kidney injury</td>
<td>119 (3.9)</td>
</tr>
<tr>
<td>Dialysis</td>
<td>2 (0)</td>
</tr>
<tr>
<td>Acute respiratory failure/pneumonia</td>
<td>191 (6.2)</td>
</tr>
<tr>
<td>Acute myocardial infarction</td>
<td>7 (0.2)</td>
</tr>
<tr>
<td>Low-output syndrome</td>
<td>34 (1.1)</td>
</tr>
<tr>
<td>Gastroenteric complications</td>
<td>56 (1.8)</td>
</tr>
<tr>
<td>Atrial fibrillation</td>
<td>601 (19.5)</td>
</tr>
<tr>
<td>Sternal wound complications</td>
<td>20 (0.6)</td>
</tr>
</tbody>
</table>

Figure 2: Computed tomography angiography 12 years after surgery showing the II-circuit between the LIMA and the right internal mammary artery (Y graft) and the right internal mammary artery and the distal segment of the LIMA. CX: circumflex artery; diag: diagonal branch; ILIMA: left internal mammary artery, distal segment; IRIMA: free right internal mammary artery; lad: left anterior descending artery; LIMA: left internal mammary artery; Mg: marginal branch.
Isolated CABG n=3517: February 2001 – May 2016

Postoperative complications

- AKI: 4.2%
- AF: 19.4%
- Lung: 6.5%
- Reopening: 1.0%
- Post IABP: 1.3%
Isolated CABG n=3517: February 2001 – May 2016

Primary end points - 30days

<table>
<thead>
<tr>
<th>End Point</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality</td>
<td>1.12%</td>
</tr>
<tr>
<td>CVA</td>
<td>0.40%</td>
</tr>
<tr>
<td>AMI</td>
<td>0.26%</td>
</tr>
</tbody>
</table>